from this building was significant and probably occurred over a number of years. For example, in 1986 while upgrading an unfiltered storm water line leading to Outfall K015, a subcontractor discovered a large volume of TCE during an excavation. It is not known how long this release had been occurring, and the quantity of TCE released was never determined. Normal operations presented numerous possibilities for TCE releases in addition to those that have been documented. For example, TCE releases are likely to have been associated with C-720 compressor pit operations, as evidenced in part by the existence of the southwest TCE plume.

Interviews with past workers confirmed the accepted practice of disposal of TCE down building drains not only in C-400, but also at many other process and support facilities on site. This practice occurred from the early Plant operations through the 1970s. Workers also confirmed that TCE was periodically dumped onto the ground at locations near numerous process and support buildings and during cleaning operations in the switchyards. There was apparently a belief that the material would evaporate quickly and cause no harm to the environment.

The outdoor storage and placement of contaminated waste and scrap that began in the late 1950s (e.g., Drum Mountain and scrap yards) has continuously contributed to the spread of contamination through surface water runoff. Contaminants settled in onsite ditches and streams. As a result, in the late 1980s efforts were undertaken to characterize and plan for remedial measures to address these contaminants. Limited removal and access controls were established in the 1990s. The Phase I Oversight investigation provided additional characterization of the contaminants in streams and ditches in the vicinity of the Plant.

Drum Mountain

From the beginning of PGDP operations, the C-615 sewage treatment plant treated sanitary wastewater (sewage and sink wastes) from process and support buildings. Radiological components of treated water caused the sewage sludge to be contaminated with uranium. Subsequently, this material was unknowingly spread at various locations at the site, creating contamination control problems. In 1977, the C-616 wastewater treatment plant came on line. Major liquid effluent streams that feed into the North-South Diversion Ditch were then routed by a lift station to the 616 facility, resulting in a significant improvement in water quality in local streams.

The major component of liquid process waste during early Plant operations was the recirculating cooling water—approximately 500,000 gallons per day, with a 20 ppm concentration of chromium. An additional 80,000 gallons per day of cooling and scrubber tower water contained soluble fluorides. The cooling water was pumped to Little Bayou. At one time, the Little Bayou was a dead stream in parts and was actually colored yellow by the chromium from the cooling water. In response to changing Federal requirements for pollution control, the use of chromium in cooling water was phased out.

4.4 Atmospheric Releases of Radioactivity and Fluorine/ Fluorides

- *Stack Emissions*
- *Accidental Releases*
- *Diffuse and Fugitive Emissions*
- *Planned Emissions*

Radioactive and fluorine/fluoride air emissions to the atmosphere began with startup in 1952 and have continued to the present from USEC operations regulated by NRC. The air emissions from the site were from process stacks, diffuse and fugitive emission sources, accidental releases, and a limited number of planned releases.

Stack Emissions

The site did not perform stack monitoring until the mid-1970s, so the actual quantities of radionuclides released to the environment from routine operations before that time are unknown. From 1959 to 1974, the air emission reports consisted of ambient air monitoring.

Starting in mid-1960, continuous ambient air samples were taken at four locations at the perimeter fence and were analyzed for alpha and beta activity to provide input for estimation of annual ambient air concentrations. In 1961, four additional ambient continuous air samplers were installed one mile outside the perimeter fence. Since stack emissions were not measured from 1952 to 1974, the Health Physics and Hygiene Department estimated emissions based on Plant operations. Interviews indicated that the estimates were probably within a factor of two but could be off by as much as a factor of five. It was not clear whether accidents that occurred during this period were considered in the emission estimates.

The first environmental report indicating stack emissions of uranium and technetium were prepared in 1976 for the 1975 calendar year. Environmental reports for the years after 1975 also reported annual discharges to the atmosphere based on stack measurements.

The site, using available information, estimated that approximately 60,000 kg of uranium was released to the atmosphere between 1952 and 1990. Of the total, approximately 75 percent was estimated to have been released before 1965. Most of the estimated releases were attributed to the C-410 feed plant and the C-340 metals plant. C-410 was shut down in 1962, reactivated in 1968, and finally shut down in 1977; C-340 was first shut down in 1964, reactivated in 1968, and finally shut down in October 1973. When these plants were shut down, estimated air emissions from the site were greatly decreased. The calculations and methods for these estimates could not be located during this investigation.

The release of fluorides is tied closely to releases of uranium. Airborne releases of UF_6 hydrolyze with the water vapor in air to form HF. Routine releases and leaks of this material have resulted in deep etching of glass windows in a number of process buildings at the site. If the form of the uranium releases were known for the listed estimated uranium emissions, the amounts of fluoride released could be estimated. Since approximately 75 percent of uranium emissions were thought to have been released before 1965, it is probable that significant fluoride emissions occurred during the same period.

From 1959 to 1990, the air emission reports consisted of ambient air monitoring results for fluorides. Starting in mid-1960, the continuous ambient gaseous air samples at the four perimeter fence locations were analyzed for gaseous fluorides to support estimates of annual ambient air concentrations. Then, in 1961, the four additional ambient continuous air samplers one mile outside the perimeter fence were used. However, actual stack monitoring of fluoride emissions did not occur until the mid-1970s. The first environmental reporting of fluorine stack emissions that was found was for 1986 emissions; only limited information was found for stack emissions of fluoride prior to 1986. For the period 1986 through 1990, annual discharges to the atmosphere were reported in annual emission reports based on stack measurements.

Accidental Releases

A number of accidental releases to the atmosphere have occurred at PGDP. This Office of Oversight investigation examined several lists of accidents. One of these lists, associated with UF_6 releases from cylinders, identified 15 accidents that released more than 50 pounds of UF_6. Another listing identified about 300 material releases (most of them accidental) from July 1, 1952, to July 1, 1972. These included releases to the atmosphere and some discharges to water. Sixty-nine (excluding routine stack emissions) were probable airborne releases of more than 10 pounds of uranium each. No evidence could be found that any of the accidental releases were analyzed using a meteorological model for assessing whether there were any significant acute doses to the public.

From 1960 to 1974, heavy reliance was placed on ambient air samples for assessing impact on the public. However, ambient air samples were not always available, and they only measure plumes at ground level. Lofted plumes might not be measured, depending on the meteorological conditions. Plume lofting is expected during accidental releases of UF_6, since the reaction between the UF_6 and water vapor releases heat. The expected plume lofting was observed during two accidental releases on May 20, 1958. An attempt was made to sample the plumes downwind from the Plant. The first plume was observed to intersect the ground, while the second plume remained elevated. In addition, based on the results of a limited set of measurements, the statement was made that established MPCs were not exceeded for this release. This conclusion is probably valid; however, such conclusions are only generally valid for a well designed field test run under ideal conditions where peak concentrations can be observed. During the second set of measurements, the plume was elevated, and only the maximum concentration at the ground near the Plant and under the elevated plume was reported. In this case, the peak concentrations in the plume were probably not observed.

In addition to accidental releases of uranium, a number of accidental releases of HF occurred. For example, an analysis was performed in 1975 to explain high gaseous fluoride readings in the ambient air samples. In this occurrence, system failures in the feed plant were attributed to the high readings. Other accidental or unplanned releases have also occurred. For example, several former and current workers interviewed reported blue flames 10 inches high in the classified landfill after a heavy rain.

Diffuse and Fugitive Emissions

Diffuse and fugitive emissions were generally not calculated for the site from 1952 through 1990. A limited set of data exists for releases during the mid-1950s from some processes, such as uranium metal pickling, smoking ash receivers, and drum dryer exhaust. Workplace air samplers and contamination on roofs and ground in the site area point to the occurrence of unmonitored releases. One example is the C-404 Holding Pond. Uranium-contaminated water was originally piped to the pond, and in 1957 the pond was turned into a solid waste burial area. A ramp was later constructed to reduce dust emissions from the area. After the mid-1960s, the ambient air samplers could have reflected some air concentration contributions to diffuse and fugitive emissions. However, no modeling studies were performed to evaluate how those samples might represent these emissions. Also, only low volume samples were taken. This Oversight investigation found no evidence that the performance of the low volume ambient air sampler network was ever evaluated under a variety of wind and weather conditions. There was no evidence that diffuse and fugitive emissions were substantively included in release inventories and subsequent public dose calculations. Also, even though diffuse emissions of transuranics would have occurred during pulverizing of the feed plant receiver ash, no estimates of these emissions were found.

Diffuse and fugitive emissions of fluorides were not calculated for the site from 1952 through 1990. In addition, the investigation team did not have sufficient information to estimate releases of fluorides using the limited set of data for uranium releases during the mid-1950s. However, as discussed under UF_4 and metal production (see Section 3.2.3), the release of fluoride from the production of UF_4 was the probable cause of ecological damage in the areas around C-340.

Planned Releases

Four planned atmospheric releases of UF_6 occurred at PGDP: two 4.4 kg releases in 1955 and two 0.68 kg releases in 1974. These releases were designed to model plume behavior from a surface release and were followed by an additional series of tests where approximately 160 grams of UF_6 was released at ground level directly into the atmosphere. Finally, six releases occurred in the 1975-1976 timeframe, involving a total of approximately 1 kg of UF_6.

As described in Section 3.2.2, there is some evidence that planned releases occurred when preparing the cascade cells for maintenance. Jetting of the cells, possibly to decrease the concentration of uranium in the cells, was accomplished by releasing UF_6 from vents on the roofs of the process building. The frequency and amounts of the releases are unknown. Because a large quantity of uranium could have been involved, jetting of the cascades could be a major contributor to the annual releases. Interviews with the former health physics manager revealed that contaminants jetted to the atmosphere in cascade buildings were not factored into release estimates.

4.5 Environmental Management Summary

The waste management program at the Plant reacted to external requirements. The waste management program that was implemented during the 1980s eventually was able to correct waste activities that had been inadequately managed for years. However, large volumes of waste materials accumulated on site with inadequate characterization for waste classification and disposal. Controls on waste disposal practices were not stringent or fully implemented in the early years of Plant operations, resulting in the creation of numerous disposal sites at the Plant. Additionally, based on employee interviews and a review of procedures and correspondence, it is clear that radiological waste materials were inappropriately disposed of in old and sanitary landfills used at the Plant before the sanitary landfill was permitted by the Commonwealth of Kentucky. Interviews with current and former workers identified locations where waste was discarded around the site from the very early days of operations. With few exceptions, these locations correspond to past landfills, scrap yards, lagoons, and spill sites that have been identified as SWMUs as part